

## **xi. Large Aperture CQ Assemblies**

For these assemblies, the cold mass helium containment half shells were welded around the individual quadrupoles and correctors. This was in contrast to the standard aperture CQS assemblies described earlier, where the half shells were welded around the corrector, quadrupole, and sextupole cold masses as a single unit. There, the shortness of the quadrupoles allowed the use of internal tie rods to support the quadrupole end plates, which restrain the axial Lorentz force of the coils. The greater length of these quadrupoles required the stiffness of the shell to act as support for the magnet end plates. Once fitted with its shell, each Q2 and Q3 quadrupole was welded end-to-end to its respective corrector or correctors to form a single CQ cold mass (Q2's had one corrector, Q3's had two.) Weld stripes on the shell were used to improve the alignment of the correctors with respect to the quadrupoles [CO97a]. For the CQ2 units, the mean corrector offset was 0.15 mm with 0.2 mm rms. For the CQ3 units, produced later, the mean was 0.04 mm, with 0.16 mm rms. Nearly all the correctors had offsets less than 0.5 mm. CQ assemblies were not cold tested.